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MAMMALS FROM THE LATE PLEISTOCENE/EARLY HOLOCENE OF SAN LUIS PROVINCE (ARGENTINA) AND PALAEOENVIRONMENTAL INFERENCES [1]

(With 15 figures)

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ABSTRACT: This report informs about the findings of extinct mega-mammals of the Late Quaternary in San Luis Province, produced between 1993 and 2003. They constitute the first descriptions with geographic and stratigraphic references correctly identifiable. The remains are dominated by *Equus (Amerhippus) neogeus, Stegomastodon platensis, Sclerocalyptus ornatus, Megatherium americanum*, and *Scelidotherium leptocephalum*. This association establishes its link to the Lujanense Mammalian Age recognized in the Pampean region; it also suggests a strong similarity with the climatic conditions prevailing during the Late Maximum Glacial Ice. The relatively scarce and partially fractured presence of fossil mammals as well as some stratigraphic evidences suggests a larger severity in the environment taking into account its closeness to the area of contribution of arenas and Patagonian slimes and the Andean glacial fronts.

Key words: Megafauna. Late Quaternary. San Luis Province. Climatic conditions.

RESÚMEN: Los mamíferos fósiles del Pleistoceno Tardío-Holoceno temprano en la Província de San Luis (Argentina). Inferencias paleoambientales.

Se dan a conocer los hallazgos de megamamíferos extintos del Cuaternario Tardío de la provincia de San Luis, producidos por el autor y colaboradores entre 1993 y 2003, los que constituyen las primeras descripciones con referencias geográficas y estratigráficas correctamente identificables. Los restos están dominados por *Equus (Amerhippus) neogeus, Stegomastodon platensis, Sclerocalyptus ornatus, Megatherium americanum* y *Scelidotherium leptocephalum*. Dicha asociación establece su vinculación con la Edad Mamífero Lujanense reconocida en la región pampeana, a la vez que sugiere una fuerte similitud con las condiciones climáticas dominantes durante el Ultimo Máximo Glacial. La relativamente escasa y parcialmente fracturada presencia de los restos fósiles, sumada algunas las evidencias estratigráficas, sugiere una mayor rigurosidad en el ambiente, considerando su cercanía al área de aporte de arenas y limos patagónicos y los frentes glaciares andinos.

Palabras claves: Argentina. San Luis. Cenozoico. Mamíferos. Paleoambiente.

INTRODUCTION

San Luis Province is located in the center-west of Argentina between 31°50' and 36°00'S and 64°69' and 67°22'W. It is 700km west of the Atlantic Ocean and 250km east of the Andes Mountains. The largest area of the relief is a plain with a height between 600 and 700m above sea level, whereas in the highland zone there are 2,200m above sea level. The fossil remains recognized in this report were exhumed at Depresión Oriental, Planicie Medanosa Austral and Sierra de San Luis (Fig.1).

Field references and comparative quotations about the presence of Quaternary fossils in isolated areas of this region are known since the end of the XIX century. However, the first work of description, illustration, and cataloguing of the remains was produced at the end of the last century (Tognelli *et al.*, 1993). Additionally, radio carbon dating of those remains improved the quality of these records (Chiesa, 2005).

The objective of this contribution is to submit a present-day condition about the knowledge of the presence of Quaternary fossil mammals in San Luis Province as well as producing a general characterization of bearing sediments and paleoenvironmental conditions prevailing during the Late Pleistocene and Recent Holocene.

Antecedents

The major stratigraphic and paleontological contributions related to the Upper Quaternary of

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San Luis have been produced in the last 30 years. In this context, the most significant antecedents referring to the stratigraphy of Quaternary deposits of San Luis Province is attributed to SANTA CRUZ (1979) whose proposal was debated by LATRUBESSE & RAMONELL (1990) who put forward a new lithostratigraphy. PASCUAL & BONDESIO (1981) and COSTA *et al.* (1997/2002) published important compilations on the sediments and scarce fossils of the area. Several other published and unpublished studies at a zonal range generated significant advance in the knowledge of sedimentary characteristics of the main geomorphologic units. Their most highlighting contribution was the progressive clarification about the space and/or temporal distribution with the detailed descriptions of the outcrops, sometimes associated with microflora and megafauna.

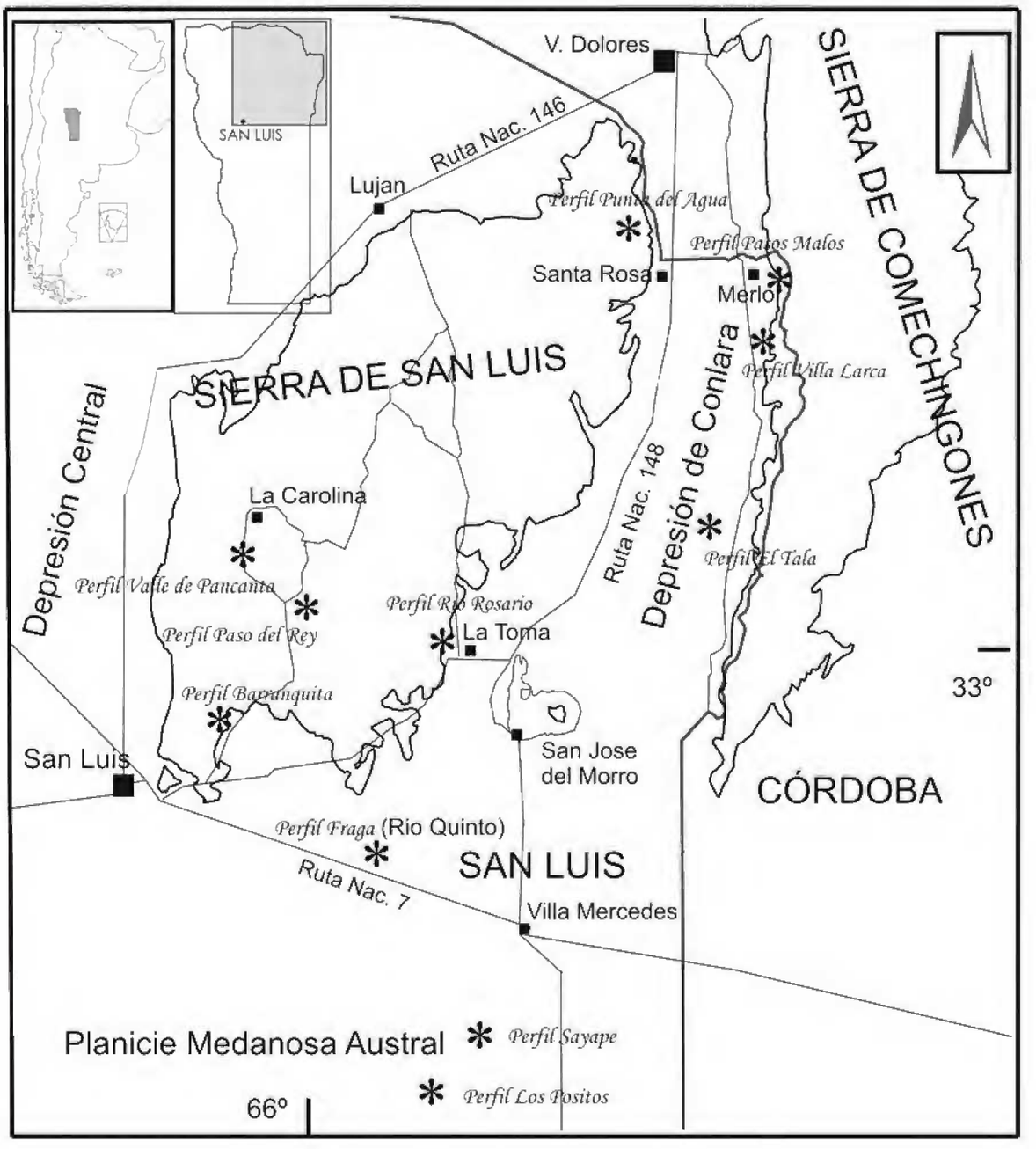

Fig.1- Map of the location of the main quaternary fossiliferous localities (*) of San Luis Province.

Finally, Costa *et al.* (1997/2002) presented contributions with a detailed compilation and description of stratigraphic profiles representative of the Quaternary of the central and northern region.

From the paleontological point of view, the first historical and synthetic review linking geology and Quaternary fossils from San Luis corresponds to the study of Strasser *et al.* (1992). In this respect, the oldest citations belongs to De Moussy (1860) who mentioned, "it is told that in some plains of Sierra de San Luis there are very voluminous fossil skeletons. All our searches have been fruitless and we have not been able to gather evidences". A similar situation was commented by Ave Lallemant (1875) in Cañada de Zavala. Although he pointed out having found "a rib", it is not presented a further description of the fragment.

Adaro (1917) was the first researcher that presented descriptions and illustrations of the Pleistocene xenarthra and ungulates of San Luis remains. The author referred at the point 1 (:4) "the first fossil that came to our hands was a *Megatherium* dorsal vertebra found on the left shore of Río Quinto" without providing the date of such finding, whereas in the point 2 (:7) he mentioned that "later, in 1901, we received another bone that was better fossilized, colored in black as if it were coal and found by our friend Antenor Orueta on the left shore of Río Conlara and on the alley that departs from San Pablo to La Riojita. It is the ileum of a *Megatherium*". Adaro went on describing the finding of fossil remains in the Quaternary successions of different spots close to Sierra de San Luis supplied by villagers from 1910 until 1926. The finding of a *Megatherium* vertebra in the zone of El Morro was presented by Pastore (1915). A very important reference for the time is Frenguelli (1931). The author registered the occurrence of *Megatherium americanum greslebini*, *Scelidotherium* sp., *Lestodon* sp., "*Eumylodon*" sp. (*Mylodon* sp.), *Panochtus sp.*, "*Auchenia*" sp. (*Lama* sp.), *Macrauchenia* sp., *Equus* sp., and "*Arctotherium*" (*Arctodus*; *Arctotherium* sp.). New quotations referred to Quaternary fossils correspond to Gez (1938), who pointed out to remains assigned to "*Panochtus*, *Sclerocaliptus*, *Toxodon*, *Equus argentinus*, *Pachyrucos*, *Megatherium americanum* (the big one) and *M. lundi* (the small one), *Scelidothoerium*, *Lycodon*, *Lama* and *Paraclotherium parodi*", found in several zones of the province isolated among them. Subsequently, different geologic analyses in San Luis Province (Tapia & Rigal, 1933; Pastore & Ruiz Huidobro, 1952; Pastore & González, 1954) mentioned the presence of Quaternary fossils without producing a study of them. Those fossils were assigned to *Scleroclyptus*, *Glyptodon*, *Megatherium*, *Mylodon*, *Panochtus*, *Toxodon*, and *Equus argentinus* remains.

Finally, during the last decade studies such as those of Chiesa *et al.* (1999) and Tognelli *et al.* (2000) provided a significant advance in the description, illustration, and chronostratigraphy of Quaternary fossil remains from peripheral basins of the province highland region.

Geology

The Quaternary sediments take up the largest area of the province, approximately 85%, distributed in the plains. They overlie without agreeing with the rocks of the basement, Neopaleozoic, Cretaceous, and Neogene continental sedimentary rocks. Although units assigned to the Lower to Middle Pleistocene are proposed in some sections taking into account the fossil findings and radio carbon datings, the most ancient ones involve the Lujanense Mammalian Age or the Late Pleistocene.

From the geomorphologic point of view, San Luis Province presents two contrasting environments: the highland one and the plain one (González Díaz, 1981). The highland environment is located in the northern half like stretched strips in north-south direction and is distributed from east to west in Sierra de Comechingones, Sierra de San Luis, and Serranías Occidentales; whereas the plains take up the Planicie Austral and the inter-highland northern depressions known as Depresión Oriental with the Valle del Río Conlara, Depresión Central, and Depresión Occidental with the Valle del Río Desaguadero.

In the geomorphologic units mentioned above, the Quaternary sediments present peculiar characteristics for the region and contrast with those that are close to them including the "high pampas" where the evolution of paleosoils highlights. In general, the Planicie Austral is a stretched and monotonous sandy unit, softly wavy with dunes associated with trays of deflation sometimes occupied by bodies of water and bordered on the north by the basin of the Río Quinto.

The Depresión Oriental is a loessoid plain with outcrops isolated of the basement and bordered on the east by the softly tilted basement of Sierra de San Luis, the Valle del Río Conlara on which basin it is possible to identify fluvial psephites and psammites. On the eastern side it developed alluvial fans beginning from the steep piedmont of the Sierra de Comechingones.

The Depresión Central is a sandy loessoid semidry unit with two saline trays as depositional centers to the north (Pampa de las Salinas) and to the south (Salinas del Bebedero), and which draining is organized by a dorsal at the center of the depression. Finally, the Depresión Occidental is a wide area with a sandy cover; its fluvial-lacustrine evolution associated to Río Desaguadero is linked to the glaciers of Río Mendoza and Río San Juan of the Andes Mountains.

Regional Stratigraphic Setting

During the last 15 years, there have been contributions referred to the paleontology and the stratigraphy of the Quaternary in different areas of the provinces bordering on San Luis, fundamental to generate a paleoenvironmental model. This model allows us to come up with a biostratigraphic scheme relatively coherent for the center-west of Argentina because of its similarities and differences with other regions that have been further studied. Some contributions are related to the Córdoba region such as those of Cantú (1992), Tauber (1997), and Carignano (1999), whereas Rodríguez & Barton (1993) and Zárate (2002) produced significant advances in the description of the Quaternary of Mendoza.

Up to the present, the general biostratigraphic scheme for the Quaternary of Argentina corresponds to the Pampean region, especially Buenos Aires Province (Zanchetta, 1995; Cione & Tonni, 1995). In general, that scheme foresees that the identified units correspond to different depositional environments where the fossil remains exhumed enable a chronology based in part on the extinct megafauna. Thus, in the alluvial environment Luján Formation, the lower unit denominated Guerrero Member is assigned to the Late Pleistocene and characterized by the exclusive presence of *Megatherium americanum* and *Equus (Amerhippus) neogeus*, whereas the upper unit or Río Salado Member belongs to the Holocene and is linked to the presence of *Lagostomus maximus*.

The so-called Platense with lake characteristics and the Aeolian deposits of La Postrera Formation also correspond to the Holocene. It is possible to identify the presence of two paleosoils, Puesto Callejón Viejo (Late Pleistocene) and Puesto Berrondo (Middle Holocene), both inserted among the successions mentioned above in different areas.

Recently, Dangavs & Blasi (2003), based on their own researches and antecedents, hold the acknowledgement of La Chumbiada Member and Lobos Member as part of Luján Formation.

In San Luis, a stratigraphic scheme of the Quaternary was recently proposed by Chiesa (2005) (Fig.2). The geographic position of the actual area of study justifies in part the sedimentary differences with respect to the wide Pampean region, but with stratigraphic units more spatially enclosed probably as a response to the prevailing geomorphologic environments linking the relations proposed by Latrubesse & Ramonell (1990), Tognelli *et al.* (1993), Strasser *et al.* (1996), and Chiesa *et al.* (1999).

MATERIAL AND METHODS

The fossil material presented here is deposited in the Museo de Historia Natural of the Universidad Nacional de San Luis and registered under the reference 'MHN-UNSL-V' plus the accession number.

The data about the findings of extinct mega-mammals of the Late Quaternary in San Luis Province, here described and discussed, were produced by the author and associates between 1993 and 2003.

RESULTS AND DISCUSSION

Paleontology

Among the mammal megafauna remains of the Late Quaternary in San Luis Province, we recovered elements of *Sclerocalyptus ornatus* (Owen, 1845) (Figs.3-4), *Scelidotherium leptocephalum* Owen, 1840 (Figs.5-8), *Megatherium americanum* Cuvier, 1796 (Figs.9-10), *Stegomastodon platensis* (Ameghino, 1888) (Figs.11-14) and *Equus (Amerhippus) neogeus* Lund, 1840 (Fig.15).

Class MAMMALIA Linnaeus, 1758
Super-order XENARTHRA Illiger, 1811
Order CINGULATA Illiger, 1811
Family Glyptodontidae Burmeister, 1879
Subfamily Sclerocalyptinae Ameghino, 1895
Tribe Sclerocalyptini Ameghino, 1895
Genus *Sclerocalyptus* Ameghino, 1891
Sclerocalyptus ornatus (Owen, 1845)

Localities and descriptive aspects – Pasos Malos, El Tala, Arroyo Mundo Nuevo (La Carolina), and Cerro El Morro. An almost complete shell with part of the caudal shield and the pelvis were exhumed in Pasos Malos.

<table>
<tr><th rowspan="2">TIME</th><th rowspan="2">AREA</th><th colspan="3">SAN LUIS SIERRA</th><th colspan="2">AUSTRAL DEPRESSION</th><th colspan="3">ORIENTAL DEPRESSION</th></tr>
<tr><th>West Region</th><th>East Region</th><th>South Region</th><th>Plain</th><th>Río Quinto Basin</th><th>Río Conlara Basin</th><th>Comechingones Sierra</th><th>El Morro Hill</th></tr>
<tr><td colspan="2">HOLOCENE</td><td colspan="3">Algarrobito</td><td rowspan="6">El Chulengo</td><td>Puerta Negra</td><td rowspan="3">San Luis / Río Conlara</td><td rowspan="2">La Estanzuela</td><td>Algarrobito</td></tr>
<tr><td colspan="3">Los Toldos</td><td>Los Filtros</td><td>Los Toldos</td></tr>
<tr><td rowspan="4">PLEISTOCENE</td><td colspan="3">Barranquita</td><td>San Luis</td><td>Barranquita</td></tr>
<tr><td colspan="3">Alto Grande</td><td rowspan="2">Fraga</td><td>Uspara</td><td rowspan="2">La Unida</td></tr>
<tr><td rowspan="2">Units III / IV</td><td rowspan="2">El Pantano / Olguín</td><td rowspan="2">Donovan / del Potrero / Las Chacras</td><td>Renca</td><td>Merlo</td></tr>
<tr><td>La Petra</td><td>San Felipe</td><td>Papagallos</td><td>Los Pozos</td></tr>
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Fig.2- Stratigraphic correlation of the Late Pleistocene - Holocene units at San Luis province.

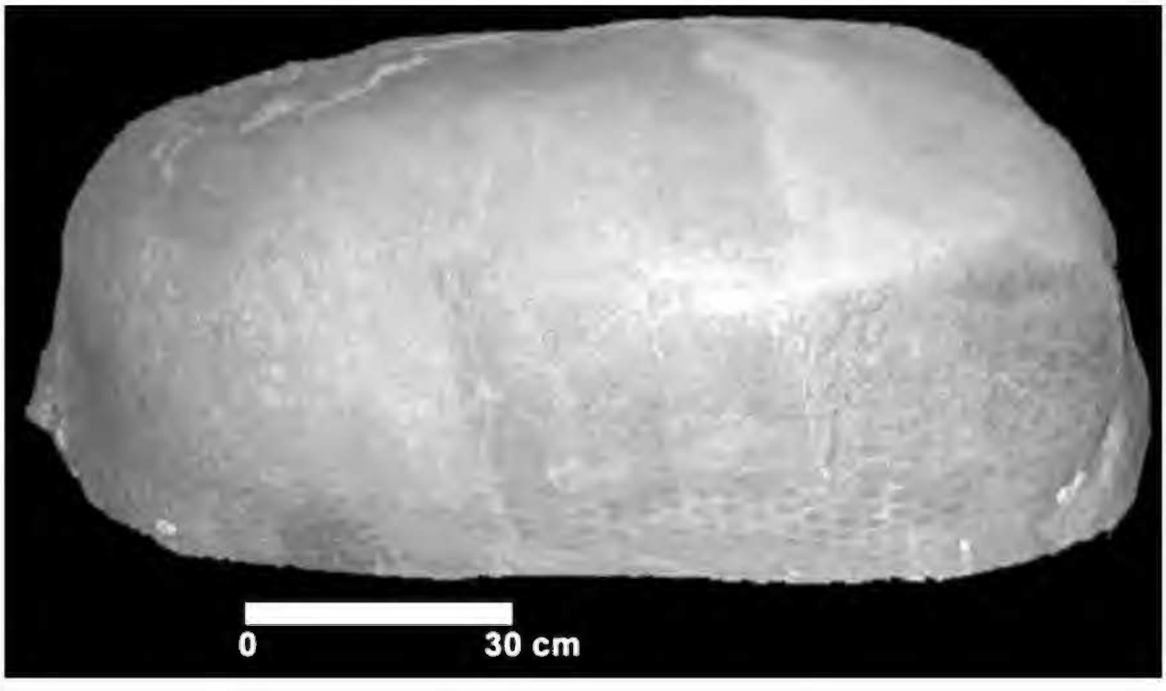

Fig.3- *Sclerocalyptus ornatus* – carapace.

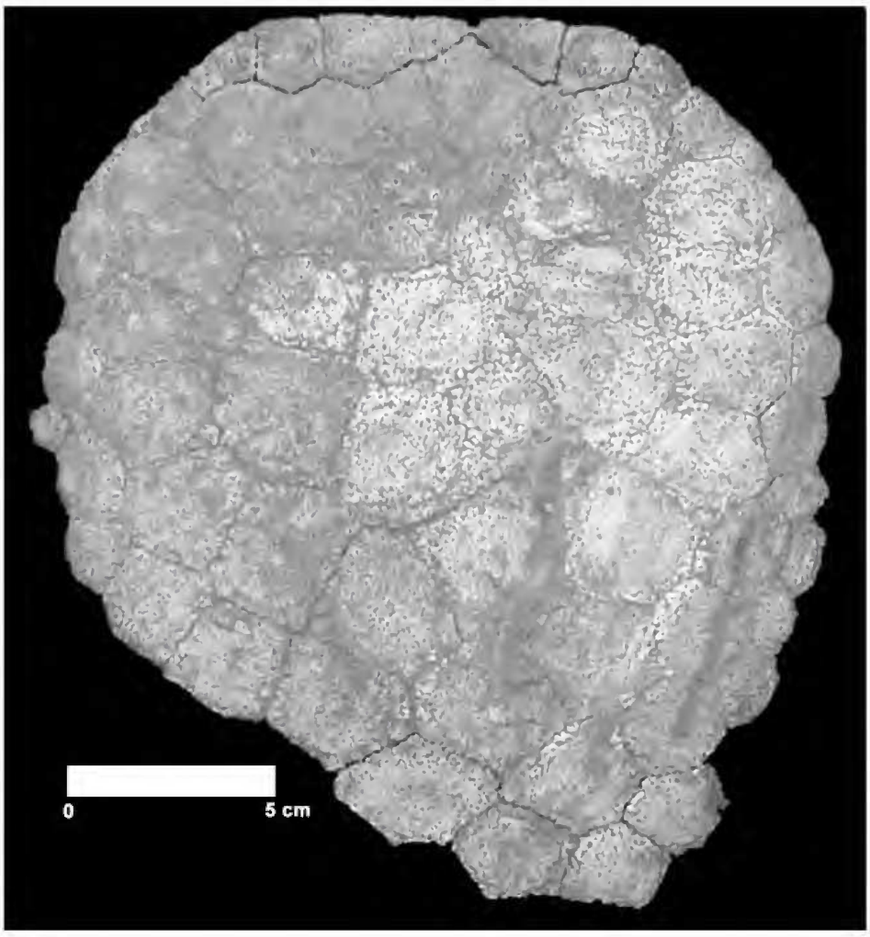

Fig. 4 – *Sclerocalyptus ornatus* - carapace fragment.

The finding in El Tala includes the complete shell, the skull, and the lower maxillary with the dentition; the cephalic small shield, ribs, and vertebrae belonging to different segments included the tail, articulate zone of the pelvic waist, extremities and plates of the movable rings of the tail. The shell is oval and low, with a fractured cupule and well-preserved anterior-lateral projections. The thin dorsal plates are hexagonally to subquadrangulary-shaped with well-defined sutures and piliferous pores. The central figure is oval and a little depressed, surrounded by peripheral polygonal figures with variable numbers (predominantly 8 to 9) with pronounced, narrow, and barely deep wrinkles. The ventral plates are smaller with rectangular shapes stretched in an anterior-posterior sense; the central figure occupies nearly all the space surrounded by small peripheral or absent figures. With regard to the extremities it can be mentioned as to have been conserved: femurs, tibiae, fibulae, right scapula, humeri, ulna, right radius, carpal, metacarpal, tarsal, and metatarsal bones. The shells assigned to Glyptodontidae recognized by the author in Arroyo Mundo Nuevo (high pampa of Sierra de San Luis) and Cerro El Morro have not been studied.

Stratigraphic and geographic distribution – It was frequently found in the deposits of the Pleistocene (Ensenadense and Lujanense Mammalian Ages) of Buenos Aires, Córdoba, Corrientes and Entre Ríos Provinces, in Argentina and in Uruguay.

Habitat – According to Fidalgo & Tonni (1983), this species lived in open areas of pastures and steppes.

Pasos Malos – MHN-UNSL-V 198.

El Tala – MHN-UNSL-V 487 to MHN-UNSL-V 500.

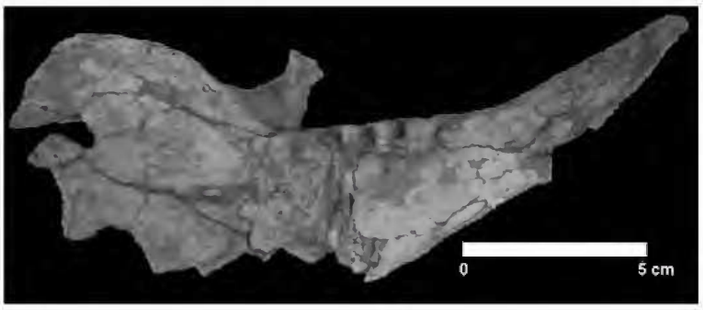

Fig. 5 – *Scelidotherium leptocephalum* – mandible fragment.

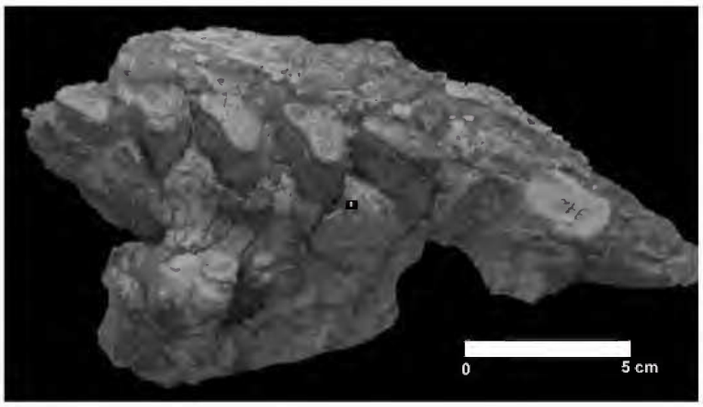

Fig. 6 – *Scelidotherium leptocephalum* – skull fragment 342.

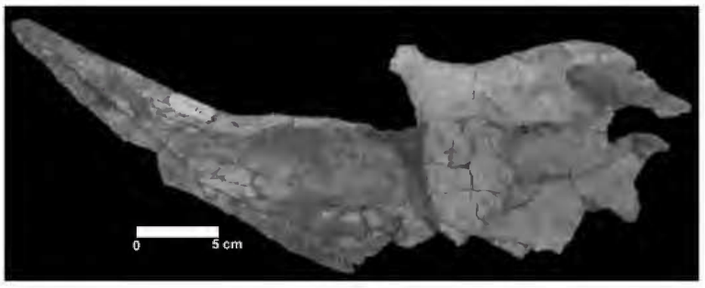

Fig. 7 - *Scelidotherium leptocephalum* – skull fragment 342.

Order TARDIGRADA Latham & Davies, 1795
Family Mylodontidae Gill, 1872
Subfamily Scelidotheriinae Ameghino, 1889
Genus *Scelidotherium* Owen, 1840
Scelidotherium leptocephalum Owen, 1840

Localities and descriptive aspects – Pasos Malos (Merlo), Villa Larca, and Valle de Pancanta. A complete skull was found in Pasos Malos. Upper and lower maxillaries with molars were found in Villa Larca. In Valle de Pancanta were found an isolated tooth; right and left femur without proximal portions; right humerus; proximal end of the left humerus; left tibia; right tibia without the proximal portion; right and left astragali; left calcaneus; four caudal vertebrae and an incomplete pelvic waist. The remains of Villa Larca correspond to the mandibular branch (without the 4th molar), the left zygomatic arch, and fragments belonging to the base of the skull with the complete left dentition and the right dentition without crown. In the horizontal mandibular branch, the part that stretches ahead of the molars is slightly curved, narrow, and extended twice the toothed region. They are molariform, prismatic, sub-triangular or sub-elliptical; the disposition is highly oblique except for the anterior-posterior stretching of the 1st upper molar with sub-equal size except for the 5th upper molar that is smaller.

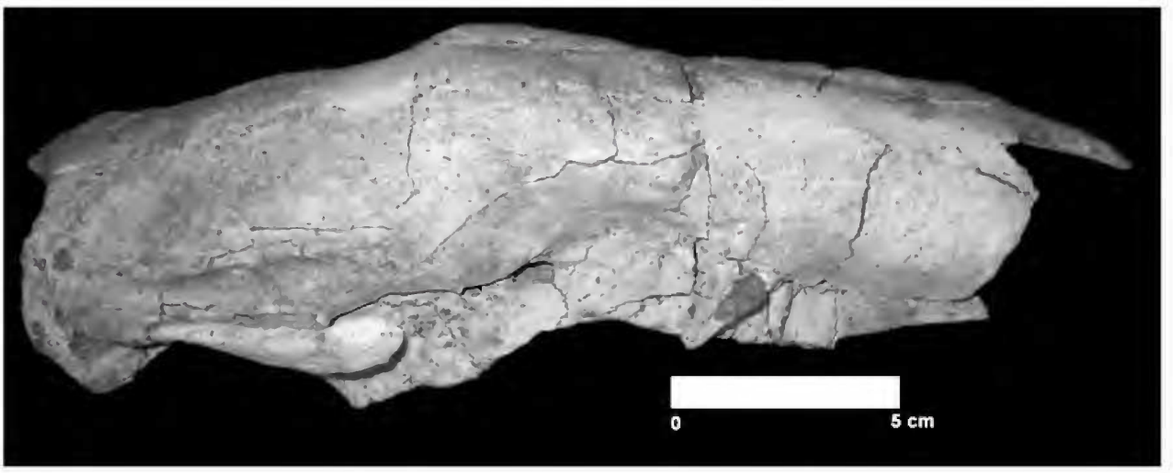

Fig. 8 – *Scelidotherium leptocephalum* – lateral view of the skull.

Fig. 9 – *Megatherium americanum* – fragment of a thoracic vertebra.

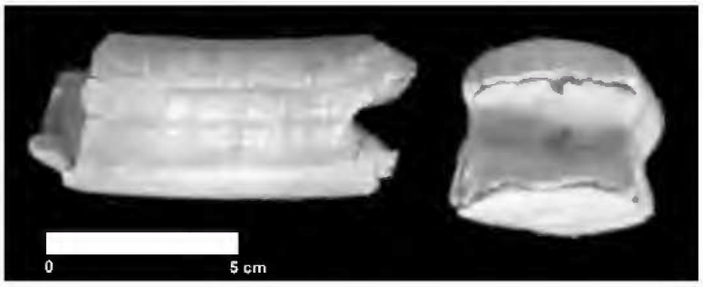

Fig. 10 – *Megatherium americanum* – molar tooth.

Fig. 11 – *Stegomastodon platensis* – first cervical vertebra (atlas).

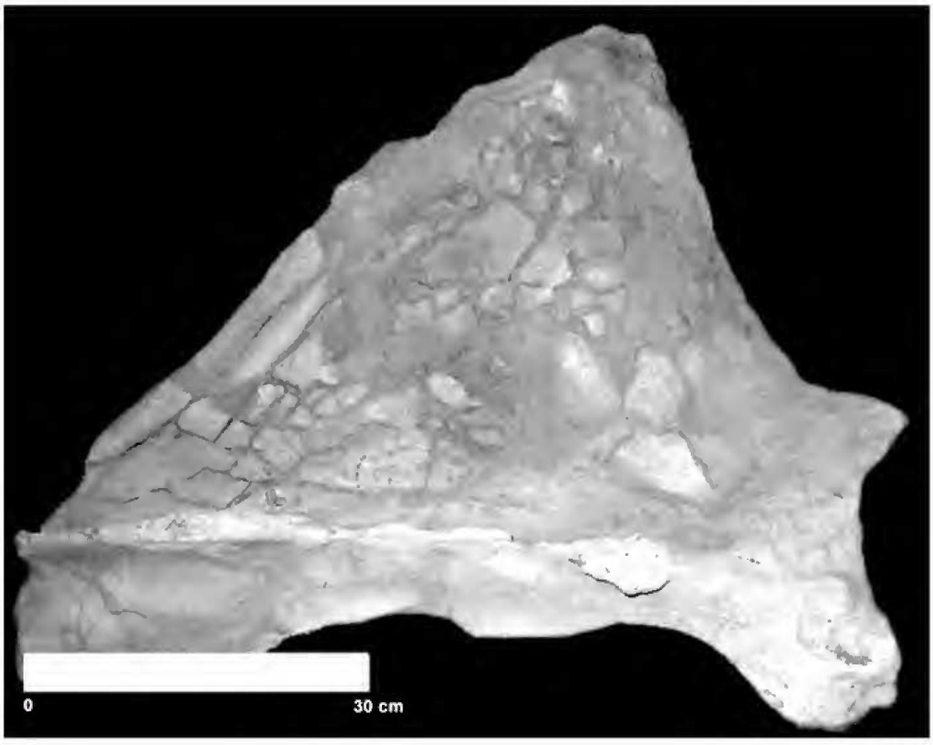

Fig. 12 – *Stegomastodon platensis* – scapula (?).

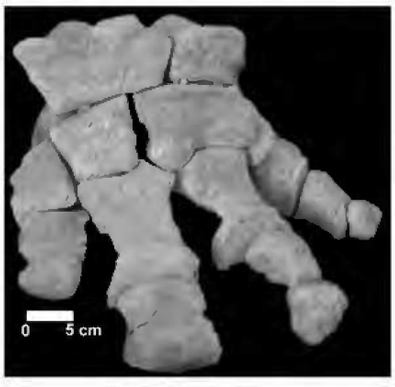

Fig. 13 – *Stegomastodon platensis* – manus.

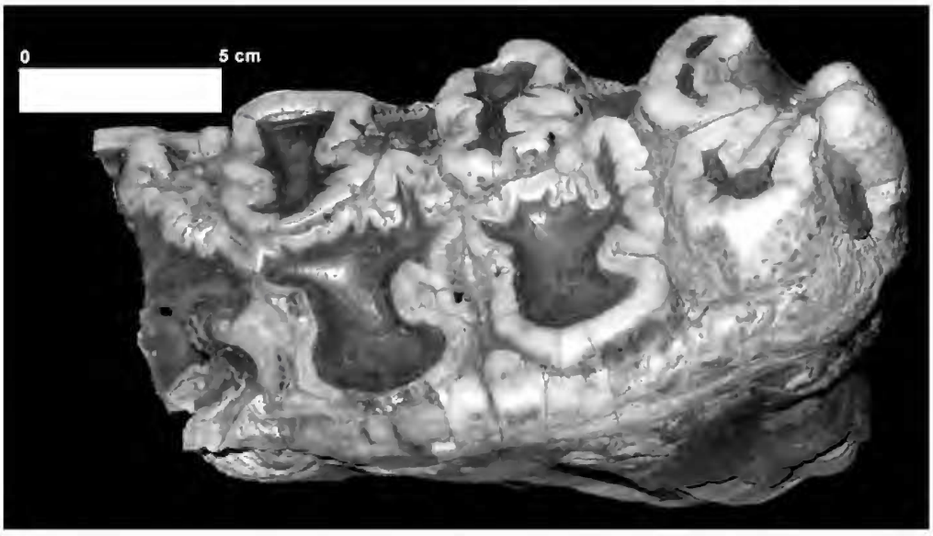

Fig. 14 - *Stegomastodon platensis* – molar tooth.

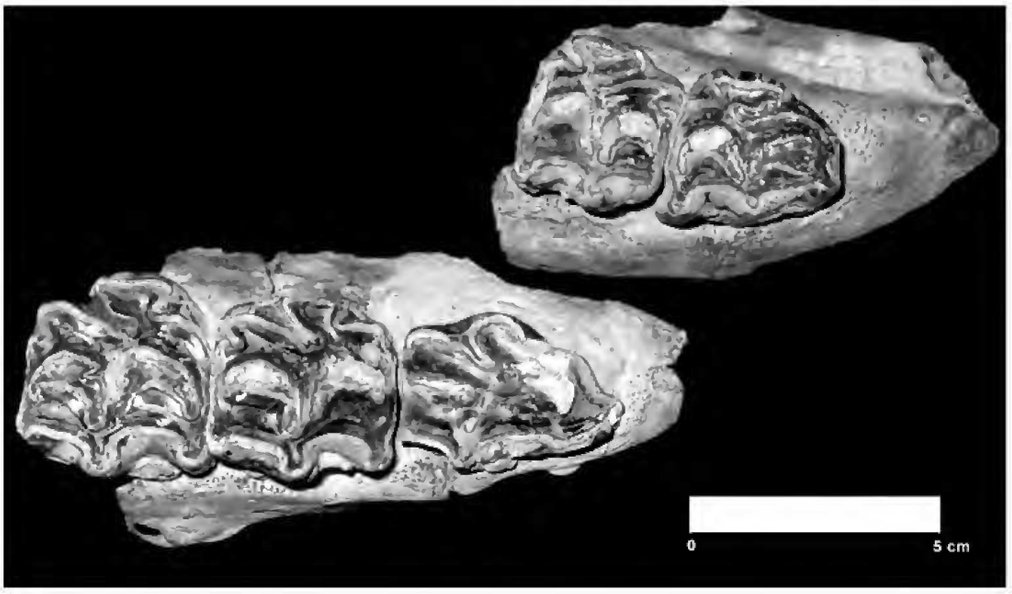

Fig. 15 – *Equus (Amerhippus) neogeus* - teeth.

Stratigraphic and geographic distribution – The gender is registered in the Pleistocene of Ecuador, Peru, Paraguay, and Uruguay, whereas in Argentina it is distributed in Córdoba, Santa Fe, Chaco, and Entre Ríos Provinces. It is frequent in the deposits of Buenos Aires Province; this species has been quoted for the Lujanense Mammalian Unit of the Late Pleistocene, in the following local faunas: Paso Otero, Luján, and Quequén-Indio Rico (Scillato-Yané *et al.* 1995; Alberdi *et al.* 1989).

Habitat – This species is characteristic of open and sub-arboreous biomes of mild climates, and their nourishment probably consisted of high pastures, shrubs and arboreous vegetation (Bombin, 1976; Deschamps & Tonni, 1992; Scillato-Yané *et al.* 1995).

Comments – In order to help with the identification, the remains of San Luis were compared to the complete skeleton that is exhibited in the hall VII of the Museo de La Plata (MLP 3-401). The species assigned to the subfamily Scelidotheriinae are of medium to large size but they are still smaller than the ones belonging to the family Mylodontidae. Among the diagnostic characters of this group we can mention the presence of the humerus with entepicondyloid hole, the calcaneus with a diagonal crest on its inferior-external face, the astragalus with internal odontoid condyle and with a very hollow articular surface for the cuboid (Cattoi, 1966). *Scelidotherium* is a middle-sized form similar to *Scelidodon* in its general structure but it has a considerable smaller size and in general it is more slender. The skull of this species is stretched, narrow, and low.

Pasos Malos (Merlo) – MHN-UNSL-V 199.

Villa Larca – MHN-UNSL-V 372, 373 y 374.

Valle de Pancarta – MHN-UNSL-V 200 to MHN-UNSL-V 211.

Family MEGATHERIIDAE Owen, 1843
Subfamily MIEGATHERIINAE Owen, 1842
Genus *Megatherium* Cuvier, 1796
Megatherium americanum Cuvier, 1796

Localities and descriptive aspects – Arroyo Barranquita, Río Quinto, Paso del Rey, Laguna Los Pocitos, and Laguna Sayape. The Arroyo Barranquita provided two isolated teeth of the right hemi-jaw (m_1 and m_4); an almost complete left radius without the distal end; a left cubitus without the distal end and with a detached proximal end; diaphysis of a right humerus with a fragment of a detached proximal end; a left humerus with both epiphysis detached; an atlas and two fragments of thoracic vertebrae; a fragment of scapula; a fragment of collarbone and fragments of ribs. Prado *et al.* (1998) quoted the finding of a femur of *Megatherium* on the ravine of Río Quinto (Fraga). Plentiful and very fractured remains belonging to the maxillary and molars tentatively assigned to this order were gathered in the Planicie Austral (Laguna Sayape and Laguna Los Pocitos) as well as the anterior mandibular and in the high pampas of Paso del Rey.

Stratigraphic and geographic distribution – Late Pleistocene of Argentina (Tonni *et al.*, 1985; Fidalgo *et al.*, 1986; Bargo *et al.*, 1986; Prado *et al.*, 1987; Politis & Prado, 1990). It was also cited for the Pleistocene of Chile (Casamiquela, 1969), Brazil (Paula Couto, 1970), Bolivia (Ortega Hinojosa, 1970), and Peru (Hoffstetter, 1970). The last record near Cuzco is the northern and of higher altitude for the species and the genus.

Habitat – This species is associated to open biomes of mild climate, arboreous vegetation that was probably its main source of food together with tall pastures and shrubs.

Arroyo Barranquita – MHN-UNSL-V 212 to MHN-UNSL-V 220 and MHN-UNSL-V 511.

Comments – The material under study corresponds to a sub-adult individual that is smaller than the Pampean specimens with which it was compared (MLP 27-VII-1-1) and the sutures of the zone of growth can still be observed in the epiphyseal region of the long bones. The bones were *in situ* but without signs of being articulated. In most of them it can be verified that the opposite face on which they lied has been affected by meteors presenting deep fissures that vary from one osseous element to the other. On the other hand, an interesting fact is the observation of the signs of an incipient deforming arthritis in the atlas. These signs seem to have been frequent in several forms of pleistocenic mega-mammals especially in the terminal forms. This kind of pathology is extremely rare because it is usually produced by recessive alleles. Nevertheless, an alteration

of this nature can become prevailing and can contribute to the extinction of these forms under conditions of nutritional stress especially in reduced populations. These kinds of alterations (petrifying osteomyelitis, periostitis, and myositis in the long bones, deforming and ankylotic spondylitis in the vertebrae and general rickets) have been cited as possible causes of extinction for some species in the Northern Hemisphere (Meléndez, 1970:106).

Order PROBOSCIDEA Illiger, 1811
Family Gomphotheriidae Cabrera, 1922
Genus *Stegomastodon* Pohlig, 1912
Stegomastodon platensis (Ameghino, 1888)

Localities and descriptive aspects – Río Conlara and Río Quinto. A complete and articulated anterior right limb, a right scapula, an atlas, cervical and dorsal vertebrae, and a molar were found in Punta del Agua (Río Conlara, Santa Rosa). Two molars with much eroded crowns were found in the ravines of Río Quinto (Fraga). Molars of anterior section or fractured trigon supposedly pentalophodont with an advanced state of erosion; relatively simple clovers provided with a few accessory conules, which are well identified only on the ends of transversal valleys and more globate in the pre-trite. The lingual and oral walls with normal inclination present the characteristic wrinkled and striated enamel along the base of the crown. The transversal valleys are narrow and it can be identified a thin cover of cementum in an even way but it is absent in the middle sulcus because of the close contact between the main conules of the post-trite and pre-trite. It is highlighted that the width of the valleys in the pre-trite section is several times smaller than the one corresponding to the post-trite that is subquadrangulary-shaped. In the occlusal area the post-trite conules present a relatively greater height than in the pre-trite; this situation is not preserved in the last lobe where the three accessory posterior conules also show a little erosion.

Stratigraphic and geographic distribution – This species is characteristic of the Middle and Late Pleistocene of Argentina especially in the Pampean Region. It is also found in Uruguay, Brazil, and Paraguay (Alberdi & Prado, 1995). This species is frequent in the Ensenadense deposits not surpassing the parallel 37° in the Pampean region in Buenos Aires Province. It is slightly frequent in the Lujanense deposits where colder and drier environmental conditions prevail. In Argentina it has been identified in Buenos Aires, Córdoba, Santa Fe, Entre Ríos, Corrientes, and Chaco Provinces (Zurita *et al.*, 2004).

Habitat – It is adapted to a mild-warm climate predominantly with pastures or savannah.

Punta del Agua (Santa Rosa) – MHN-UNSL-V 221, 222, 223, 224, 225, 226, 376 and 510.

Fraga (Río Quinto) – MHN-UNSL-V 377 and 378.
Comments – The foundations of this species are well laid, especially on the basis of cranial characteristics and the morphology of the defenses (Paula Couto, 1979). Although we do not count with these characteristics, the proportions of the humerus, the cubitus, and the radius coincide with the rank of variability of the species (maximum length of the cubitus: 64cm). Nevertheless, the remains are assigned to *Stegomastodon platensis*, considering the complicated character of M^3/M_3 for the disposition of cusps accessory, partners to choerodonty and ptychoconty, with the rifling of the enamel and the coverage of the cement in the valleys as out-standing characters (Tobien, 1973).

Order PERISSODACTYLA Owen, 1848
Family Equidae Gray, 1821
Genus *Equus* Linnaeus, 1758
Sub-Genus *Equus (Amerhippus)* Hoffstetter, 1950
Equus (Amerhippus) neogeus Lund, 1840

Localities and descriptive aspects – Arroyo Barranquita, Pasos Malos, and Río Rosario. A proximal fragment of scapula was found in Arroyo Barranquita and M^{1-2} in Pasos Malos. In Río Rosario it was found: the identified molars correspond to the lower dentition, five to the right (P_2-P_3-P_4-M_1-M_2), and three to the left (P_4-M_1-M_3); they are moderately eroded but some diagnostic characteristics of *E.* (*A.*) *neogeus* can be clearly identified. The characteristics previously mentioned are the following: the edge of the rounded metaconid and the angular metastyle; the "*ectofléxido*" without contact with the "*linguafléxido*" and varying from penetrative with respect to the "*isthmus*" and an end slightly rounded to a very shallow one with a sharp end; in general the "*linguafléxido*" is open and V-shaped; the "*prefléxidos*" are asymmetrical, and the "*pósfléxidos*" with the anterior horn with variable forms and the posterior horn slightly rounded.

Stratigraphic and geographic distribution – Late Pleistocene of the south of Brazil, in the caves of Lagoa Santa corresponding to *Equus neogeus* Lund, 1840 and *Equus principales* Lund, 1846, and the Pampean Region in Argentina (Alberdi & Prado, 1992). In this last region, *Equus* (*Amerhippus*) *neogeus* (=*E.* (*A.*) *curvidens*) is registered in the Lujanense sediments in the cities of Río Luján, Quequén Salado, Paso Otero, Arroyo Camet, Tapalqué, Lobería, and Arroyo Seco among others (Ameghino, 1889; Tonni, 1985; Tonni *et al.*, 1985; Prado *et al.* 1987, Alberdi *et al.*, 1989). It is considered a leader fossil of Guerrero Member of the Late Pleistocene of the Luján Formation (Alberdi & Prado, 2004).

Habitat – *E.* (*A.*) *neogeus* is associated to open areas of xerophilous pastures in Argentina and Brazil.

Pasos Malos (Merlo) – MHN-UNSL-V 227.

Arroyo Barranquita – MHN-UNSL-V 228, 468 and 469.

Río Rosario – MHN-UNSL-V 469.

Comments – It is here referred to *E.* (*A.*) *neogeus* even when the material analyzed is scarcely diagnostic at a specific level, especially because the material is fragmentary, although it coincides with the proportions of the specimens coming from the Pampean Region.

Paleoenvironment and Stratigraphic Relations

The present-day environment of San Luis Province is characterized by presenting different physiographic units and climates. The center and northeast of the province, the most southern spurs of the Geological Province Sierras Pampeanas, is occupied by the western edge of the Sierra de Comechingones and the Sierra de San Luis with an inter-highland region known as the Depresión de Conlara. In this area the climate presents characteristics as those of a "mild Pampean"; this links it to Córdoba, Santa Fe, and Buenos Aires Provinces.

The northwest and southern regions are depressions with dry weather. The former presents a set of small hill countries that belongs to the "dry of sierras" type. This links it to the north of Mendoza, San Juan, La Rioja, and the south of Catamarca. Otherwise, in the latter – a sandy plain –, the weather is "dry of steppe" with conditions similar to the south of Mendoza, Neuquén, the center and the west of La Pampa, and Río Negro. Such conditions, probably with limits similar to the present-day ones, prevail during the Late Pleistocene and Early Holocene, what were affected to a bigger or smaller scale by the global weather changes, especially the Late Maximum Glacial Ice. The arguments of this hypothesis are the distribution and frequency of the fossil remains and the characteristics of the sedimentary successions especially if we consider the bearing levels of the interval under study in which sediments are assigned to deposits of different paleoenvironments such as aeolian, alluvial, fluvial-lacustrine, and in all of them the development of paleoedaphic horizons.

During the Late Pleistocene there prevailed conditions of wide environmental heterogeneity and a dry-semidry character probably linked to the pleniglacial (very dry and very cold) with winter temperatures biologically non-usable and below the present-day ones (below 10°C) (Tonni *et al.*, 1985; Prado *et al.*, 1987; Alberdi *et al.*, 1989).

Consequent with these weather conditions it is proposed a faunistic association planting open areas with pastures and steppes where the seasonal rains allowed the development of temporary, shallow body waters with low energy and high evaporation making evident the presence of Ostracoda (Deschamps & Tonni, 1992). To this effect, the Late Pleistocene bird fauna of Patagonian affinity suggests an steppe and shrub-like vegetation in the south of Buenos Aires Province (Tonni & Laza, 1980).

Such conditions prevailed from the middle Pleistocene to a certain point of the Holocene (Tonni, 1985) in which they alternate with phases of higher humidity characterized by the presence of paleosoils (Tonni *et al.*, 1988). The fragmentary character and the unarticulated bone remains (except the Sclerocalyptinae) generally on the base of the present-day fluvial courses and small tracks excavated by water generated in the loessoid plains of San Luis restrict us the access to more important information from the morphological and consequently paleoecological points of view. Nevertheless, the important association collected up to the present allows us to move forward in the paleoenvironmental characterization and linking with other bordering areas.

From the stratigraphic units assigned to the Late Quaternary of Buenos Aires Province, those characteristics gathered by Luján Formation (Guerrero Member and Río Salado Member) and La Postrera Formation, as well as the edaphic horizons Puesto Callejón Viejo and Puesto Berrondo, show strong similarities with the outcropping successions

in San Luis Province. In the event of the actual contribution annotated to the Late Pleistocene, the Guerrero Member and the overlying paleosoil Puesto Callejón Viejo are tied to Barranquita Formation and the paleosoil Los Toldos.

Such relation can be regionally extended to consider the deposits of La Invernada Formation and the paleosoil Las Tapias (Cantú, 1992) in the plain of Río Cuarto (Córdoba) and the sediments assigned to La Estacada Formation and the paleosoil of the Holocene (Zárate, 2002) in the region of Tunuyán (Mendoza).

One of the problems about the current knowledge of the Quaternary in San Luis is the lack of association of the microflora and microfauna studies that would contribute to improve the interpretation about the paleoclimatic and paleoenvironmental history of the main depositional areas of the region.

To this effect, it is only available information about diatoms of a profile in the fluvial-lake environment of Salinas del Bebedero (Maidana, 1994), ravines of Río Desaguadero (Strasser *et al.*, 2000), and ravines of Río Conlara (Cappannini, 1955; Chiesa *et al.*, 1997). Likewise the only studies about pollinic evidences correspond to González *et al.* (1998) and Rojo (2003), referred to perforations in the depositional center of Salinas del Bebedero.

CONCLUSIONS

The faunistic association described is referred to the Lujanense Mammalian Age assigning the deposit of the sediments to the temporal interval Late Pleistocene-Early Holocene. The presence of *E.* (*A.*) *neogeus* and the dates of absolute dating (^{14}carbon) available for the region enclose it between ca. 22 and 8 ka. B.P.

Considering the habitat proposed for the most subjects of the faunistic set in the Pampean and Chaco region and the Aeolian (loess) character prevailing in the depositational paleoenvironmental of the bearing sediments, it can be inferred semidry paleoclimatic conditions for the region. The shortage of fossil remains in the southern and western zone is associated to a very poor availability of resources linked to a climatic situation of extreme dryness for this paleofauna characterized by sand deposits and negative hydric balances.

At the same time, in the central and northeastern zone, occupied by the sierras of San Luis and Comechingones and the inter-highland unity to them, the Depresión del Río Conlara, the paleoecological situation has been relatively different especially considering the water resource coming from the above-mentioned elevations. Likewise, the presence of an edaphic horizon also suggests some climatic stability optimum for the development of vegetation and favorable for the presence of these megaherbivora. The findings mainly come from ravines produced by the fluvial erosion of the last millennium in the area of influence of the piedmont of the highlands and linked to the basins of the rivers Quinto and Conlara; the loessoid plain developed on the east of the latter bed constitutes the area most potentially important to be explored considering the last findings of shells of *Sclerocalyptus ornatus*. A particular situation corresponds to the environment of the "high pampas" on the basement of Sierra de San Luis; there the presence of fossil remains is linked to loessoid deposits. An important development of the paleosoil, the weather conditions and especially the availability of hydric resources in such areas generated optimum paleoenvironmental conditions documented by the appearance of isolated and fragmentary remains, except the *Scelidotherium leptocephalum* of Valle de Pancanta.

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